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Protecting Africa's cattle with a live vaccine: An East Coast fever impact narrative

Did you know?

- Annual economic losses as a result of ECF are valued at over USD 300 million.
- Nearly 60% of the region's 75 million cattle are at risk of contracting ECF.
- In 1999, annual costs due to ECF in Kenya and Tanzania were estimated to be USD 95.1 million and USD 43.8 million, respectively.
- The ECF-ITM vaccine has been shown to be a highly effective product, with a 95% success rate in pastoral herds—one of the highest rates of protection offered by any livestock vaccine.
- In northern Tanzania, calf mortality rates in pastoralist areas have been reduced from 80% to as low as 2% through use of the vaccine.
- ECF vaccine has been registered in Kenya, Tanzania and Malawi, and is being used with permission of Ugandan regulatory authorities whilst awaiting formal registration.
- Four distributors in Kenya, two in Uganda and two in Tanzania are delivering the ECF vaccine.

East Coast fever (ECF), a tick-transmitted disease, causes major economic losses throughout eastern, southern and central Africa and is widely regarded as one of the most serious constraints to increasing the productivity of cattle in the region. The disease causes high mortality (>80%) and affects high-grade dairy cattle as well as young zebu cattle in pastoralist areas and ranches. For the past 40 years, ILRI's research on ECF has focused on developing better methods of controlling the disease, principally through vaccination, and obtaining a far greater understanding of the impact of the disease. A vaccine is now registered in three countries and good protection for dairy and pastoralist cattle is being achieved, particularly in eastern Africa.

Context

Caused by the parasite *Theileria parva* and spread by the *Rhipicephalus appendiculatus* tick, ECF occurs in 11 countries in eastern, southern and central Africa and kills over 1 million cattle every year. The disease is not only responsible for cattle deaths, but also results in stunting of calves and reduced milk production in animals that survive. At the household level, ECF results in reduced milk availability and incomes, undermining families' food and nutrition security. And for smallholder dairy farmers with just one or two animals, the loss of a valuable cow can represent a devastating blow. In terms of indirect impacts,

where the disease is present, farmers may be discouraged from adopting more productive but highly susceptible breeds of cattle. Pastoralists are also forced to avoid areas of high ECF risk, something that is becoming increasingly difficult as the ticks and infected cattle move into new areas, further spreading the disease.

Tick control and management against East Coast fever in Kenya (photo credit: ILRI).

ILRI's approach

ECF is a significant economic burden for poor livestock keepers, particularly in African pastoral and agropastoral production systems, making it difficult for families to plan for the future, to improve their livestock enterprises and raise their standard of living.

Over the last hundred years, ECF control has been dominated by use of acaricides to limit tick infestations. These are applied as sprays, in dips and more recently as oil-based pour-ons. However, after prolonged use the ticks develop resistance to chemical treatments and few, if any, novel acaricides are in the process of being developed. Use of acaricides also exposes users to potential health risks, which are exacerbated by lack of protective clothing amongst the poor. The chemicals can also cause environmental contamination and frequent use of acaricides is expensive—in high ECF-challenge areas application might be needed every five or so days.

In addition to this preventive approach, drugs are available for the treatment of ECF cases but, to be effective, they need to be used at an early stage of the disease. The cost per animal treated is also relatively high, especially for less valuable zebu cattle.

An alternative control strategy through immunization (vaccination) has been available for several decades. Known as the 'infection and treatment method' (ITM), it involves inoculation with live *T. parva* parasites accompanied by an antibiotic treatment to prevent the infection taking hold. The animal experiences a mild infection (as with any vaccination) but develops a long-lasting immunity to the disease.

First developed between 1967 and 1977 in Muguga, Kenya by the former East African Veterinary Research Organisation, the research on ITM involved multiple national, regional and international partners, including the International Laboratory for Research on Animal Diseases (ILRAD), now called ILRI. Various versions of the ITM vaccine have been developed, which differ in the strains of theilerial parasites in the vaccine. However, the most widely used version is known as the Mugaga cocktail, which comprises three isolates.

At the request of the UN Food and Agriculture Organization (FAO), ILRI produced the first commercial batch of the Muguga cocktail vaccine in 1996. A decade later, at the request of regional partners, ILRI produced the second commercial batch, which is now being used in eastern Africa. The production of the ECF vaccine is complicated, time-consuming and expensive (see Did you know?) The product then requires careful handling in order for it to be delivered via a cold chain and administered by trained vaccinators on farm.

However, to date, over one million cattle have received the ITM vaccine produced by ILRI. With assistance from GALVmed, ILRI registered the vaccine in Kenya, Tanzania and Malawi, and progress has been made towards registration in Uganda. In Kenya, ILRI and KARI supported the Director of Veterinary Services in successful trials to confirm the safety and effectiveness of the Muguga cocktail-based ITM vaccine, which led to the launch for national distribution in December 2012.

The commercial production of the Muguga cocktail has now been taken up by the Centre for Ticks and Tick-borne Diseases in Malawi, facilitated by GALVmed and the Bill and Melinda Gates Foundation. ILRI assisted in the establishment of the production in Malawi through the transfer of tick and parasite seed stabilates. GALVmed has also promoted the commercial distribution of the vaccine in Kenya, Tanzania, Uganda and Malawi.

Next steps

ILRI continues to play a role in the uptake of the ITM vaccine by providing technical advice. ILRI has also developed molecular tools to characterize parasite strains, which will be important in quality assurance of future vaccine productions.

Although the live vaccine has been shown to be both safe and very effective, as mentioned above, the production of the vaccine and its delivery have considerable challenges. ILRI has therefore been engaged in research directed towards obtaining a better understanding of the immune response that protects cattle against ECF and in identifying

the parasite components responsible for provoking this immunity. ILRI is leading a recently established consortium of institutes engaged in aspects of this research.

The hoped-for outcome is an alternative 'sub-unit' vaccine that will be cheaper and easier to produce and more 'user-friendly' for those delivering the vaccine. Nevertheless, there are major technical obstacles to be overcome in the development of the 'sub-unit' vaccine, and such a vaccine is several years away.

At the same time, research opportunities for improving the ITM vaccine exist. To identify the challenges in delivering the ITM vaccine and prioritize the research needed to overcome these challenges, ILRI recently cohosted, with GALVmed, a meeting of those involved in vaccine deployment—from manufacturers, directors of veterinary services and vaccine registration officials, to those delivering the vaccine in the field.

Development of a 'sub-unit' vaccine or an improved ITM would be a valuable addition in the fight against this deadly disease.

Success with pastoralists in Tanzania

Whilst scientists initially thought that the ECF vaccine would be of interest to commercial farmers only, relatively poor pastoralists in northern Tanzania have been willing to pay a relatively high price (up to USD 10/animal) for the ECF vaccine. As a result, up to 80% of calves have been vaccinated each year since 1998 across many wards, providing lifelong immunity against a disease which is responsible for half of calf deaths. 'These are livestock keepers who know cattle and who know diseases,' says Lieve Lynen of VetAgro Ltd., which has a network of community animal health workers to help in the vaccination program. 'They are willing to adopt a technology if it works—to commit themselves to a product where they see it gives them a future in livestock production.'

As a result, vaccinated animals no longer have to avoid high risk ECF areas and vaccination campaigns have reduced the amount of acaricides needed for dipping or spraying cattle. The pastoralists report that cattle with the distinctive round ECF ear-tag attract higher prices than non-vaccinated animals of equal size and their increased incomes are being used to diversify their livelihoods and send more children, including girls, to school.

Maasai in northern Tanzania pay for the East Coast fever vaccine (photo credit: ILRI/Stevie Mann).

A Maasai boy with his cattle wearing ear tags, designating that they have been immunized against East Coast fever in Tanzania (photo credit: ILRI/Lieve Lynen).

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